Photoacoustic response of common starfish tissue

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Abstract

Samples of common starfish (Asterias Rubens) tissue were prepared in a thick film form for study of the photoacoustic (PA) response. A broad absorption band in the visible range (peak at about 570 nm) of the electromagnetic PA spectrum has been registered while in ultraviolet range the absorption bands from the π π*, π n charge transitions were detected. The visible PA spectra strongly depend on sample decomposition processes in air. This measured PA spectrum is very similar to the obtained earlier spectrum of another living organism Truncularopsis trunculus. The absorption band near 570 nm is also similar to that obtained for spermidine which plays an important role in information transfer to DNA. The obtained results are noteworthy as they confirm experimentally that very old organisms absorbed particularly intensely that part of the Sun radiation which is transparent in water. The Sun's radiation could also play a role of an ignition agent in metabolic processes in the human body. The influence of Sun's specific radiation ranges filtered by the Earth atmosphere on diabetes patients is discussed and a possible role of transition metal complexes present in blood is considered.

Experimental

The Asterias Rubens specimen from Korynth Golf region is presented in Fig. 1. PA spectra were measured by using thin film sample of Asterias Rubens at room temperature, on conventional equipment comprising a light source of a 1 kW power xenon arc lamp with a ¼ m ORIEL monochromator of a bandpass width of 5 nm at 500 nm. Signal bandwidth narrowing to reduce the low frequency noise was accomplished by the use of lock-in detection. The light output from the monochromator was mechanically chopped at a frequency of 10 Hz. The acoustic signal was detected by a TREVIE M27, a very sensitive microphone, attached to the PA cell. A dual Stanford Research SR830 lock-in amplifier recorded the amplitude and phase of the microphone signal relative to the input excitation. For an averaging of 20 modulation periods, the signal-to-noise ratio was at least 50 for a particular wavelength of incident light, representing an approximately five-fold improvement over the unmodulated case. All the data was very good at reproducibility. The raw amplitude and phase of the sample signal were normalized for the PA spectrum of a graphite blackbody reference in order to correct for the modulation frequency dependence of the thermal diffusion length [13].

Fig. 1. A common starfish from Korynth Golf.

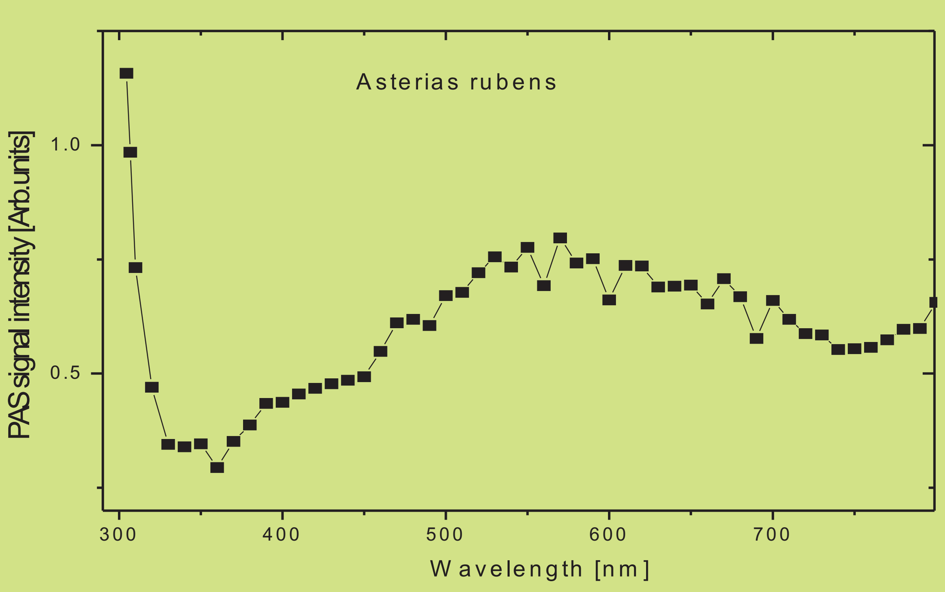

Fig. 2. PA spectrum of Asterias Rubens.

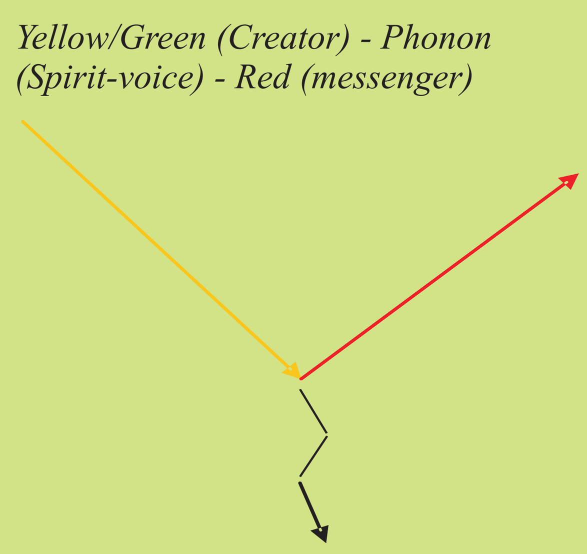

Fig. 3. The symbolic radiation model.

Samples	Wavelenght [nm]	Sources
Spn323	567	[6]
Spm323	566	[7]
Hematite	580	[14]
Truncularopsis Trunculus	570	[3]
Asterias Rubens	570	This work
Sea Urchin	570	[17]
$[Nd(NO_3)_2(PiBH)_2]NO_3$	583	[10]

Table 1. Maximum PAS absorption in a visible region of radiation.

Experimental and results

Figure 2 presents the PA spectra of Asterias Rubens tissue. An intense and broad absorption band in the visible region was recorded near the yellow/green of the PA spectra with maximum at 570 nm. Several times more intense PA spectra arising from charge transfer transitions (π π*, π n) were observed below 350 nm. The PA spectra in the visible region depended strongly on water deficiency in the tissue

The PA spectrum is the result of the heat generated through the nonradiative transitions in sample after absorption of periodically varying incident light. The PA intensity (I) could be expressed by relation: $I=\gamma k A_{abs}$ where γ is a coefficient related to sample`s thermal properties and the spectrometer`s characteristic, k is the probability of non-radietive transition from an exited state, and A_{abs} is sample`s absorbance [14]. Two kinds of relaxation processes should be considered: the radiative and nonradiative after excitation of electrons by the electromagnetic radiation. The observed PA spectra are due to the nonradiative processes which could involve directly the localized levels of ions or indirectly the molecular levels.

The fact that very similar PA spectra are obtained for Asterias Rubens and Truncularopsis Trunculus is very important and suggests that this particular electromagnetic radiation could play an important role in dynamical processes in the living matter.

From the ancient times people try to understand the so called "The God's Spark". It is well known that even a small dose of energy of photons could exite strongly (energetically) the living matter, e.g. by eyes contact. The first question which should be answered concerns the role of the yellow/green radiation played in 'εν λειτουργία' (reproduction) of living matter in the water. The living matter is build up mainly from water molecules. Water is increasingly transparent with increase of the length of electromagnetic radiation. Do the other parts of human body have similar properties as eyes in relation to photons interactions have? The answers of the above questions could help to resolve two related mysteries: formation of the living matter and accomplishment of Sun radiation in therapy used by ancient Greeks.

Figure 3 presents a proposed symbolic radiation model that attempts to explain the so called "The God's Spark".

Conclusion

The Asterias Rubens tissue has a similar PA response as previously studied Truncularopsis Trunculus and Sea Urchin . The maximum of intensity of the d-d transitions is registered at about 570 nm (yellow/green colour). It is an important result that may suggest that for the living matter the influence of photons of that particular energy is essential. The water surrounding the organism may play a very significant role in determining the crucial function of the d-d electron transitions in the living system.